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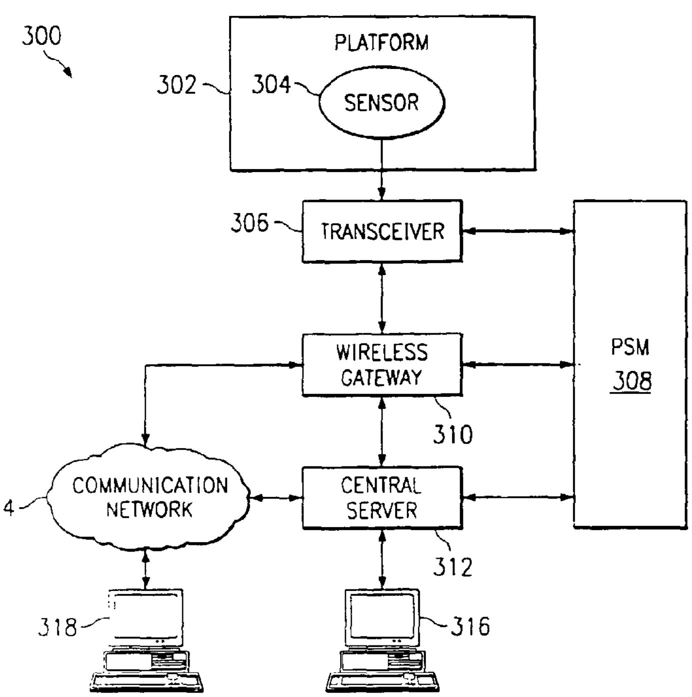
(54) Title: SYSTEM AND METHOD FOR WIRELESS COMMUNICATION OF SENSED DATA TO A CENTRAL SERVER



(57) Abstract: A system and method are disclosed which enable sensed data to be communicated to a central server for processing thereon. In a preferred embodiment, the system includes at least one sensor capable of sensing a physical characteristic and outputting data representing such physical characteristic to a transmitter (or transceiver). The transmitter communicates the data in a first wireless protocol to a wireless gateway, which is capable of communicating in a plurality of different wireless protocols. For example, the wireless gateway may be capable of communicating in a plurality of the following wireless protocols: short-range radio protocol (e.g., Bluetooth), WLAN protocol (e.g., 802.11 or wireless medical transmission standard (WMTS)), and cellular protocols (e.g., CDPD, EDGE, HDR, CDMA, or WCDMA). The wireless gateway translates the data from the first wireless protocol to at least a second wireless protocol, and communicates the data either directly or indirectly to a central server using the at least a second wireless protocol. For example, the transmitter may communicate the sensed data in Bluetooth protocol, and the wireless gateway may translate the sensed data into another protocol, such as cellular, for further communication thereof. One or more intermediaries may be included for receiving data from the wireless gateway and communicating such data to the central server. Such an intermediary may receive the data from the wireless gateway in a particular wireless protocol, and may communicate the data to the central server in a different protocol, such as Internet Protocol. The central server receives and processes the data.

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SYSTEM AND METHOD FOR WIRELESS COMMUNICATION OF SENSED DATA TO A CENTRAL SERVER

RELATED APPLICATIONS

This application is related to concurrently filed and commonly assigned U.S. Patent Application Serial Number 09/676,382 entitled "WIRELESS GATEWAY CAPABLE OF COMMUNICATING ACCORDING TO A PLURALITY OF PROTOCOLS," the disclosure of which is hereby incorporated herein by reference. This application is also related to co-pending U.S. Patent Application Serial Numbers 09/157,607, filed September 21, 1998, entitled "Full-Fashioned Weaving Process for Production of a Woven Garment with Intelligence Capability," and 09/273,175, filed March 19, 1999, entitled "Fabric or Garment with Integrated Flexible Information Infrastructure," the disclosures of which are hereby incorporated herein by reference. This application is also related to co-pending U.S. Provisional Application Serial Number 60/142,360, filed July 6, 2000, entitled "Fabric or Garment with Integrated Flexible Information Infrastructure for Monitoring Vital Signs of Infants," the disclosure of which is hereby incorporated herein by reference.

TECHNICAL FIELD

The present invention relates in general to a system and method for communicating data to a central server, and in specific to a system and method which utilize a multi-protocol wireless gateway to enable communication of sensed data to a central server for processing thereon.

BACKGROUND

Sensors are available in the prior art for detecting various physical characteristics of a person, animal, or an environment and outputting data about such physical characteristics. For example, sensors are available for outputting vital sign data or other data relating to a person, such as heart rate or EKG, pulse, voice, temperature, blood oxygen levels, atmospheric exposure, such as chemical and biological exposure, atmospheric smoke and oxygen levels, and radiation exposure. Sensors typically communicate such sensed data to a monitoring device, which interprets the sensed data, stores the sensed data, and/or analyzes the sensed data. A monitoring device may analyze the sensed data and output the data in an understandable format (e.g., in line graph form), and may also output, for example, warnings about a detected characteristic.

Sensors for detecting physical conditions are commonly utilized in the health care arena, such as within a care giver's facility (e.g., a hospital, clinic, or nursing home). Turning to Fig. 1, a typical environment commonly implemented in a care giver's facility of the prior art is shown. As shown, care giver facility 100 may include various patients, such as $Patient_1$ and $Patient_2$. Each patient may have one or more sensors, such as sensors 102_A, 102_B, and 102_C, for detecting and outputting personal data (e.g., vital sign data) to an associated monitoring device, such as monitoring devices 104_A, 104_B, and 104_C. Thus, for example, monitoring devices 104_A and 104_B may be heart monitors that receive heart rate data from sensors 102_A and 102_B respectively, and monitoring device 104_C may be a blood pressure monitor that receives blood pressure data from sensor 102_C. As further shown in Fig. 1, the monitoring devices generally include a software application program (e.g., application programs 110_A, 110_B, and 110_C), and a processor for executing such software application programs (e.g., processors 108_A, 108_B, and 108_C). Additionally, the monitoring devices typically include some type of input/output device (e.g., input/output devices 106_A, 106_B, and 106_C), such as keypads for inputting information and displays, printers, and speakers for outputting information. Furthermore, the monitoring devices typically include memory (e.g., memory 112_A, 112_B, and 112_C) for storing data, such memory may include any suitable type of data storage device, such as random access memory (RAM), a tape drive, a hard drive, a floppy disk, a writeable CD-ROM drive, etcetera.

Within the monitoring devices, the software application programs are typically executable to receive the sensed data and interpret such sensed data. The software

application programs are also typically executable to analyze the sensed data and output a representation of the sensed data and/or warnings via the input/output devices of the monitoring equipment. For example, a heart monitor may execute an application program to monitor the sensed heart rate data and display the heart rate on a display, and the application program may, upon determining that the heart rate is at a dangerous level, sound a warning to notify care givers of the detected condition. The monitoring devices commonly store sensed data to its memory (e.g., to its data storage device), and often a care giver will access the stored sensed data to evaluate the patient's condition based on such collected data.

It should be recognized that the monitoring devices of the prior art are typically stand-alone devices, which are each assigned/dedicated to a particular patient. For example, suppose monitoring devices 104_A and 104_B are heart monitors, and further suppose that $Patient_1$ and $Patient_2$ require having their heart rates monitored. The monitoring devices are patient-dependent, in that one heart monitor (e.g., monitor 104_A) is dedicated specifically for monitoring $Patient_1$ and another heart monitor (e.g., monitor 104_B) is dedicated specifically for monitoring $Patient_2$. Accordingly, prior art systems typically require that a monitoring device, including the software for interpreting/analyzing received sensed data and input/output devices for communicating relevant information about the sensed data, be dedicated to an individual patient.

Turning to Fig. 2, a further environment that may be implemented in the prior art is shown. As in Fig. 1, a care giver's facility 100 includes one or more patients, such as $Patient_1$ having sensor 102_A for detecting and outputting personal data (e.g., vital sign data) to an associated monitoring device 104_A. Again, monitoring device 104_A generally includes application program 110_A executing on processor 108_A to interpret/analyze received sensed data, as well as input/output devices 106_A and memory 112_A. In this implementation of Fig. 2, a transmitter 202, which may transmit data via wireless protocol, is coupled to monitoring device 104_A and communicates data from monitoring device 104_A to a local server 204 within the care giver's facility 100. Accordingly, local server 204 may collect data from various monitoring devices to allow care givers to monitor the vital statistics of patients within the care giver's facility 100 from a central monitoring station coupled to local server 204, such as personal computer (PC) 205. Additionally, care givers may use

handheld wireless devices, such as handheld monitor 206, that are capable of receiving data from transmitter 202 and/or local server 204 to monitor the status of one or more patients.

As further shown in Fig. 2, local server 204 of facility 100 may be communicatively coupled to a communication network 208, such as a public switched telephone network (PSTN), wide area network (WAN), or the Internet, as examples. Accordingly, care givers external to facility 100 may monitor the status of patients within facility 100 via communication network 208. That is, care givers may access the data available on local server 204 from a remote location via communication network 208. As one example, another health care facility 200 may include a server 212 that is remote from server 204, and remote server 212 may be capable of accessing information on local server 204 via communication network 208 and vice-versa. Thus, for instance, a number of hospitals (e.g., facilities 100 and 200) may be communicatively networked together to allow care givers in each hospital to access data from the other hospitals within the network. As another example, a care giver may utilize PC 210 (or other processor-based device) to access data contained on local server 204 or on remote server 212 via communication network 208.

It should be recognized that the system of Fig. 2 aids in allowing care givers to be mobile and still monitor the status of patients. For example, handheld device 206 allows a care giver to be mobile within facility 100, while still having continuous access to the status of $Patient_1$. Additionally, such prior art system enables a care giver to be mobile between various facilities. For instance, a care giver may use remote server 212 of 200 to monitor the status of $Patient_1$ residing within facility 100. Furthermore, such prior art system enables a care giver to monitor the status of $Patient_1$ from other locations outside of facility 100 and facility 200. For instance, a care giver can use PC 210 to monitor the status of $Patient_1$ from the care giver's home, office, or other location.

However, various problems and/or shortcomings exist in such prior art systems. First, while the prior art systems assist in mobilizing care givers, such systems typically do not allow for mobilizing patients. For example, in most prior art systems, a patient is relatively immobile with respect to monitoring devices and/or the care giver's facility. For instance, in Fig. 2, $Patient_1$ is typically confined to monitoring device 104_A. While monitoring device 104_A may be relatively mobile (e.g., relatively small and/or implemented on wheels or other transportable base), $Patient_1$ is required to remain confined to relative

close proximity of monitoring device 104_A. Furthermore, $Patient_1$ is typically confined to facility 100 for monitoring. For example, transmitter 202 typically transmits data to local server 204 only from within facility 100. Thus, a desire exists for a system and method that enable increased mobility of patients while still allowing personal data of the patients to be monitored.

Additionally, in typical prior art systems, monitoring devices that each include input/output, processor, application software, and memory are dedicated to each patient. Accordingly, because a separate monitoring device is required for each patient, such monitoring devices are not cost effective to implement or to update. For example, if an update is made for the software executing on a monitoring device, the update is required to be made at each monitoring device. Additionally, periodic maintenance and troubleshooting is typically required for the various components of each monitoring device to ensure proper operation. Furthermore, such monitoring devices of the prior art typically require that the care giver use the software programs provided by the manufacturer of such monitoring devices. Thus, a care giver may have little or no option in selecting a desired software program for interpreting/analyzing sensed data. Accordingly, a desire exists for a system and method in which a central server receives the sensed data and executes application program(s) to analyze and/or store the data for monitoring patients. Thus, dedicated monitoring devices each including software, memory, and other complexity, may be eliminated, and instead their functionality may be provided by a central server.

Typically, in prior art monitoring systems, the sensed data (e.g., the data output by sensor 102_A of Fig. 2) is communicated to a monitoring device (e.g., monitoring device 104_A of Fig. 2) for processing, and resulting processed data is then communicated to a local server. Thus, processed data, rather than the raw sensed data, is communicated to the local server. Accordingly, the capability of local server 204 in further processing (e.g., further monitoring/analyzing) the received data may be limited and/or skewed because the received data is the result of the processing of monitor 104_A, rather than the actual raw sensed data from sensor 102_A. As one example, suppose sensor 102_A in Fig. 2 senses a patient's heartbeat, and outputs data indicating each sensed heartbeat to monitor 104_A. Monitor 104_A may interpret the sensed heartbeat data to determine a heart rate, and may further determine whether the determined heart rate is normal. This processed data (e.g., the determined heart rate and/or the determination of whether the heart rate is normal) is then communicated to

local server 204. Thus, local server 204 is limited in the amount of further processing that it can perform because it does not receive the actual raw sensed heartbeat data. For instance, local server 204 may not utilize a software program that is superior to the program executing on monitor device 104_A in order to more accurately determine the heart rate, because local server 204 receives pre-processed data, rather than the raw sensed data. Accordingly, a desire exists for a system and method that enable raw sensed data to be communicated to a central server for processing thereon.

Furthermore, typical prior art monitoring systems do not utilize bi-directional communication. For instance, in the system of Fig. 2, while monitoring device 104_A utilizes transmitter 202 to communicate information to local server 204, information is typically not communicated from local server 204 to monitoring device 104_A. Thus, for example, a user typically cannot control the operation of monitoring device 104_A from local server 204 because local server 204 is not capable of communicating information/instructions to monitoring device 104_A. Accordingly, a desire exists for a system and method that enable bi-directional communication between monitoring devices and/or sensors and a central server.

Furthermore, the prior art system is inflexible in the manner in which sensed data may be communicated to a server. For example, wireless transmitters, such as transmitter 202 of Fig. 2, for transmitting data to a server, such as local server 204 of Fig. 2, typically utilize one wireless communication protocol and provide no flexibility for communicating via other protocols. Thus, the compatibility of transmitter 202 with a particular server is limited to the particular protocol utilized by transmitter 202. Also, should the wireless communication network utilized by transmitter 202 become unavailable for some reason, transmitter 202 has no ability to communicate information (e.g., via an available protocol) to the server. Thus, a desire exists for a system and method that provide flexibility in the communication of data.

SUMMARY OF THE INVENTION

The present invention is directed to a system and method which enable sensed data to be communicated to a central server for processing thereon. A preferred embodiment provides a system that includes at least one sensor capable of sensing a physical characteristic and outputting data representing such physical characteristic to a transmitter. The transmitter communicates the data in a first wireless protocol to a wireless gateway, which is preferably capable of communicating in a plurality of different wireless protocols. For example, the wireless gateway of a preferred embodiment may be capable of communicating in a plurality of the following wireless protocols: short-range radio protocol (e.g., Bluetooth), WLAN protocol (e.g., 802.11 or wireless medical transmission standard (WMTS)), and cellular protocol (e.g., CDPD, EDGE, HDR, CDMA, or WCDMA). In a most preferred embodiment, such transmitter is actually implemented as a transceiver that is capable of not only transmitting sensed data, but is further capable of receiving data, thereby enabling bi-directional communication.

The wireless gateway translates the data from the first wireless protocol to at least a second wireless protocol, and communicates the data either directly or indirectly to a central server using such second wireless protocol. Accordingly, in a most preferred embodiment, the wireless gateway is capable of translating the sensed data from one communication protocol to another. As one example, the transmitter may communicate the sensed data in Bluetooth protocol (or other short-range radio protocol), and the wireless gateway may translate the sensed data into another protocol for further communication thereof, such as WLAN protocol (e.g., 802.11 or WMTS) or cellular protocol. Most preferably, the wireless gateway may be implemented as disclosed more fully in concurrently filed and commonly assigned U.S. Patent Application Serial Number 09/676,382 entitled "WIRELESS GATEWAY CAPABLE OF COMMUNICATING ACCORDING TO A PLURALITY OF PROTOCOLS," the disclosure of which is hereby incorporated herein by reference. The central server receives and processes (as well as stores) the data.

In a preferred embodiment, a platform may be included on which one or more sensors is coupled. In a most preferred embodiment, such platform is fabric having an information infrastructure integrated therein. Furthermore, in a most preferred embodiment, the fabric is fashioned into a wearable garment, thereby enabling one or more

sensors coupled to the garment's information infrastructure to sense physical characteristics of the wearer of such garment.

A preferred embodiment may be implemented to include at least one intermediary for receiving data from the wireless gateway and communicating such data to the central server. Such an intermediary may receive the data from the wireless gateway in a wireless protocol, and may communicate the data to the central server in a different protocol, such as Internet Protocol. The intermediary may be implemented to communicate the data to the central server via a communication network, such as a public switched telephone network (PSTN), wireless communication network, general purpose processor-based information network, dedicated communication lines, cable system, digital subscriber line (DSL), direct PC to PC connection, local area network (LAN), wide area network (WAN), modem to modem connection, the Internet, an Intranet, an Extranet, or any combination thereof suitable for providing information communication between such intermediary and central server. As an example, a base unit may be located at a nurses station in a hospital to receive sensed data for the patients in a hospital from the wireless gateway(s), and the base unit may communicate such data to a central server via the hospital's Intranet. As another example, a base unit may be located in a patient's home to receive sensed data for the patient in the patient's home from the wireless gateway, and the base unit may communicate such data to a central server via the Internet.

While a most preferred embodiment is implemented within the health care arena to communicate sensed data from a patient (e.g., vital sign data) to a central server, it should be understood that the present invention may be implemented in various other arenas. As one example, a preferred embodiment may be implemented to enable communication of sensed data (e.g., temperature data) to a temperature control system or air conditioning system (central server) responsible for controlling the temperature of a particular facility. As another example, a preferred embodiment may be implemented within a robot to detect hazardous conditions in an environment and communicate the sensed data acquired in such an environment to a central server. Additionally, any type of physical characteristic capable of being sensed is intended to be within the scope of the present invention. For example, in a preferred embodiment, one or more sensors are implemented to sense physical characteristics, such as vital sign characteristics or environmental characteristics. Examples of such vital sign characteristics include heart rate, breathing rate, blood pressure,

pulse, body temperature, and blood oxygen level, and examples of such environmental characteristics include temperature, audio, atmospheric smoke and oxygen levels, gas level, light level (e.g., light brightness or intensity), air flow, and radiation level.

Most preferably, the raw sensed data is communicated to a central server for processing. That is, in a most preferred embodiment, the actual sensed data is communicated to a central server, rather than communicating to the central server information resulting from processing of the actual sensed data. Additionally, in a preferred embodiment, the communicated data includes information in addition to the actual sensed data. For example, the communicated data may also include such information as physical characteristic type, source identification, time stamp, and location information.

It should be appreciated that a technical advantage of one aspect of a preferred embodiment is that it enables increased mobility of patients (or other "source") while still allowing personal data of the patients to be monitored. Another technical advantage of one aspect of a preferred embodiment is that it enables a central server to receive sensed data, thereby enabling the central server to execute software program(s) to analyze and/or store the data. Accordingly, dedicated monitoring devices that each include software, memory, and other complexity, may be eliminated, and instead their functionality may be provided by the central server of a preferred embodiment.

It should also be appreciated that a further technical advantage of one aspect of a preferred embodiment is that it enables raw sensed data to be communicated to a central server for processing thereon. Accordingly, analysis of such sensed data may be made at the central server, rather than receiving at the central server an analysis of the sensed data performed by another device. Yet a further technical advantage of one aspect of a preferred embodiment is that it enables bi-directional communication between the source of the sensed data and a central server. Still a further technical advantage of one aspect of a preferred embodiment is that it provides flexibility in the communication of data to a central server. For example, a wireless gateway capable of communicating in a plurality of wireless protocols is preferably utilized to enable flexibility in the communication of sensed data to a central server.

The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may

be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims. The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present invention.

BRIEF DESCRIPTION OF THE DRAWING

For a more complete understanding of the present invention, reference is now made to the following descriptions taken in conjunction with the accompanying drawing, in which:

Fig. 1 shows a typical environment commonly implemented in a care giver's facility of the prior art;

Fig. 2 shows a further environment that may be implemented in the prior art for communicating sensed data within a care giver's communication network;

Fig. 3 shows an exemplary environment in which a preferred embodiment of the present invention may be implemented;

Fig. 4 shows an exemplary environment in which a most preferred embodiment may be implemented;

Fig. 5 shows an exemplary implementation of a preferred embodiment within a hospital environment for communication of sensed data within the hospital environment;

Fig. 6 shows an exemplary implementation that enables communication of sensed data from a particular base location, such as a patient's home, to a central server;

Fig. 7 shows an exemplary implementation that further enables communication of sensed data to a central server not only from a particular base location, but also from a wide area; and

Fig. 8 shows an exemplary implementation that enables communication of sensed data to a central server from within a wide area of communication.

DETAILED DESCRIPTION

Various embodiments of the present invention are now described with reference to the above Figs., wherein like reference numerals represent like parts throughout the several views. Turning to Fig. 3, an exemplary environment 300 in which a preferred embodiment of the present invention may be implemented is shown. As shown, a platform 302 may be provided, which includes one or more sensors 304. As will be described in greater detail hereafter, sensors 304 preferably detect a physical condition (or physical characteristic) and outputs data representing the physical condition. Most preferably, sensors 304 detect personal data, such as vital sign data for a person, and communicate the detected information to a transceiver 306. However, sensors 304 may detect other physical characteristics, such as environmental data (e.g., temperature, gas level, light level, air flow, radiation level, or other hazardous level of an environment). As will also be described in greater detail hereafter, platform 302 preferably provides an infrastructure that enables various sensors 304 to be added thereto and removed therefrom to easily modify the "sensing system" provided by platform 302. In a preferred embodiment, transceiver 306 receives sensed data from the one or more sensors 304, digitizes the sensed data, and communicates the received data via wireless communication. In a most preferred embodiment transceiver 306 is capable of both transmitting and receiving data. However, in alternative embodiments, a transmitter may be implemented in place of transceiver 306, enabling wireless transmission of data received from the one or more sensors 304. Transceiver 306 may use, for example, short-range personal area network (PAN), short-range radio, or WLAN to communicate data, or transceiver 306 may be implemented as an optical transceiver capable of communicating via infrared, as examples.

Preferably, environment 300 includes a wireless gateway 310, which is most preferably a multi-protocol gateway that is capable of communicating in a plurality of different wireless protocols. For example, wireless gateway 310 may be capable of communicating in a plurality of the following wireless protocols: short-range radio protocol (e.g., Bluetooth), WLAN protocol (e.g., 802.11 or WMTS), and cellular protocols (e.g., CDPD, EDGE, HDR, CDMA, or WCDMA). Such protocols are well-known in the art, and therefore will not be described in great detail herein. Additionally, it should be recognized that wireless gateway 310 may be implemented with the capability of communicating in any desired wireless protocol now known or developed in the future, and any such

implementation in intended to be within the scope of the present invention. In a most preferred embodiment, wireless gateway 310 is capable of translating the sensed data from one communication protocol to another. As one example, transceiver 306 may communicate the sensed data in Bluetooth protocol (or other short-range radio protocol), and wireless gateway 310 may translate the sensed data into another protocol for further communication thereof, such as WLAN protocol (e.g., 802.11 or WMTS) or cellular protocol. Most preferably, wireless gateway 310 may be implemented as disclosed more fully in concurrently filed and commonly assigned U.S. Patent Application Serial Number 09/676,382 entitled "WIRELESS GATEWAY CAPABLE OF COMMUNICATING ACCORDING TO A PLURALITY OF PROTOCOLS," the disclosure of which is hereby incorporated herein by reference.

From wireless gateway 310, the sensed data is communicated, either directly or indirectly, to central server 312. In a most preferred embodiment, wireless gateway 310 communicates with transceiver 306 via a first wireless protocol (e.g., Bluetooth), and communicates, either directly or indirectly, with central server 312 via a different wireless protocol. In a preferred embodiment, wireless gateway 310 communicates with central server 312 via a communication path, at least a portion of which is via a wireless protocol. For example, wireless gateway 310 may communicate via a wireless protocol directly with central server 312. Thus, the entire communication path between wireless gateway 310 and central server 312 may be a wireless communication path using such wireless protocol. As a further example, wireless gateway 310 may communicate indirectly via a wireless protocol with central server 312. For instance, wireless gateway may communicate via a wireless protocol to an intermediary, which may forward the communication to central server 312 via a different wireless or wireline protocol. For example, an intermediary may forward the communication to central server 312 via the Internet. Thus, only a portion of the communication path between wireless gateway 310 and central server 312 may be via a wireless protocol utilized by wireless gateway 310.

In a most preferred embodiment, central server 312 processes the data that it receives (either directly or indirectly) from wireless gateway 310. For example, the data received at central server 312 may be processed by one or more software programs operating thereon. That is, various software programs may be operating on central server 312 to receive, interpret, analyze, monitor, and/or store the sensed data communicated

thereto. Central server 312 may be any suitable processor-based device for receiving and processing the sensed data including without limitation a personal computer (PC) or mainframe computer. Furthermore, it should be understood that central server 312 may actually comprise a plurality of processor-based devices communicatively coupled together; and gateway may be communicated from wireless gateway 310 to all of such plurality of processor-based devices simultaneously, and/or such data may be communicated from one of such processor-based devices to the next of such devices. Additionally, while only one platform 302 is shown in Fig. 3, it should be understood that in a preferred embodiment, many such platforms may be implemented, and central server 312 may receive data sensed by all of such platforms. Further, each platform may have associated therewith its own transceiver 306, as well as its own wireless gateway 310 in order to communicate sensed data to central server 312. Alternatively, multiple platforms may share a single transceiver 306 and/or a single wireless gateway 310. Thus, in some embodiments, wireless gateway 310 may be utilized to communicate sensed data from a plurality of platforms, each having one or more sensors, to central server 312. Furthermore, each platform may include one or more various sensors 304.

Because a preferred embodiment enables sensed data to be communicated from various different sensors 304 to a central server 312, rather than each sensor communicating data to a separate, dedicated monitoring device, the quality, efficiency and cost effectiveness of processing such data can be improved at central server 312 to improve the overall processing (e.g., monitoring/analysis) of the sensed data. Thus, for example, in a most preferred embodiment the functionality of the monitoring devices of the prior art (e.g., monitoring devices 104_A, 104_B, and 104_B of Figs. 1 and 2) may be provided by central server 312, thereby eliminating the requirement of providing monitoring devices that are dedicated solely to a particular sensor or platform (e.g., dedicated to a particular patient). As will be discussed in greater detail hereafter, in some implementations transceiver 306 and/or wireless gateway 310 may include data processing (e.g., monitoring/analysis) functionality. However, in a most preferred embodiment, central server 312 provides the primary processing functionality.

In a preferred embodiment, a user can select the most desirable software program(s) to be utilized at central server 312 for processing (e.g., monitoring/analyzing) the sensed data. Thus, for example, a user is not limited specifically to software provided by the

manufacturer of a monitoring device, but may instead choose one or more of various different software program(s) to be utilized at central server 312 for processing the sensed data. Additionally, software programs may be utilized to process data received from multiple sensors on platform 302 in order to more fully monitor/analyze the overall condition of platform 302 or some entity (e.g., a patient) associated with platform 302. Using a software program to monitor data collected from various different sensors is typically not available in the prior art. For example, in the prior art the output of a heart sensor is generally monitored by a heart rate monitoring device, and the output of a blood pressure sensor is generally monitored by a blood pressure device. However, a system that allows for data from a heart sensor, data from a blood pressure sensor, as well as data from various other sensors, to be collectively processed by such system to monitor/analyze the overall condition of a patient is typically not available. Thus, a preferred embodiment is advantageous in that it enables data from various different sensors to be collectively processed to evaluate the condition of platform 302 or an entity (e.g., a patient) associated with platform 302.

As further shown in Fig. 3, in a preferred embodiment a user, such as a care giver (e.g., a physician or nurse), may access data from central server 312 via a suitable processor-based device, such as devices 316, 318 and 308. For example, processor-based device 316, which may be any suitable processor-based device including without limitation a personal PC or laptop computer, may be communicatively coupled to central server 312 to enable a user to access data from central server 312. Similarly, processor-based device 318, which may also be any suitable processor-based device including without limitation a PC or laptop computer, may be communicatively coupled to central server 312 via communication network 314 to enable a user to access data from central server 312. Communication network 314 may be any suitable communication network, including without limitation a public switched telephone network (PSTN), wireless communication network, a general purpose processor-based information network, dedicated communication lines, a cable system, digital subscriber line (DSL), direct PC to PC connection, a local area network (LAN), a wide area network (WAN), modem to modem connection, the Internet, an Intranet, an Extranet, or any combination thereof suitable for providing information communication between processor-based device 318 and central server 312.

Additionally, a handheld device 308, such as a personal digital assistant (PDA), pager, or 3G cellular telephone, may be capable of communicating with one or more of central server 312, wireless gateway 310, and transceiver 306. Handheld device 308 may be referred to herein as a "personal status monitor" ("PSM"), and may enable an entity associated with platform 302 (e.g., a patient) to monitor sensed data and/or receive warnings/instructions. For example, a warning (e.g., an audible alarm) may be provided by PSM 308 upon detection by PSM 308 or central server 312 of a dangerous condition based on the sensed data, and/or instructions may be provided from central server 312 to PSM 308 to educate the entity associated with platform 302 as to appropriate actions to take. Additionally, PSM 308 may be a device used by an entity not associated with platform 302, such as a care giver responsible for a patient being monitored by platform 302. In this manner, for example, a nurse, physician, or other care giver may use PSM 308 to monitor the status of one or more patients. Preferably, PSM 308 is a wireless device capable of receiving data via a wireless protocol, such as Bluetooth.

A most preferred embodiment of the present invention has particularly desired application within the health care arena to communicate sensed personal data (e.g., vital sign data) from one or more patients to a central server. However, as will be recognized by one of ordinary skill in the art, various embodiments of the present invention may be implemented within many other arenas. Thus, the present invention, therefore, is not intended to be limited solely to application within the health care arena or solely to the communication of personal data of patients to a central server, but instead may be implemented within various other arenas (some of which are briefly mentioned herein) and may be implemented to communicate various other types of sensed data to a central server.

Turning to Fig. 4, an exemplary environment 400 in which a most preferred embodiment may be implemented is shown. As shown, a platform 402 is provided, which includes one or more sensors 403. As illustrated in Fig. 4, in a most preferred embodiment, platform 402 is implemented as fabric that includes an integrated infrastructure in which sensors 403 may be implemented. Most preferably, such fabric is fashioned into a wearable garment such that sensors 403 may detect physical characteristics (e.g., personal data) from the person wearing the garment and/or about the physical characteristics of the environmental surroundings of such person. Such a fabric platform may be implemented in the manner described in greater detail in co-pending U.S. Patent Application Serial

Numbers 09/157,607, filed September 21, 1998, entitled "Full-Fashioned Weaving Process for Production of a Woven Garment with Intelligence Capability," and 09/273,175, filed March 19, 1999, entitled "Fabric or Garment with Integrated Flexible Information Infrastructure;" and also as in co-pending U.S. Provisional Application Serial Number 60/142,360, filed July 6, 2000, entitled "Fabric or Garment with Integrated Flexible Information Infrastructure for Monitoring Vital Signs of Infants," the disclosures all of which are hereby incorporated herein by reference. Thus, for instance, as shown in the example of Fig. 4, platform 402 may be a wearable fabric garment (e.g., a shirt, a vest, pants, shorts, a cap, etcetera). In alternative embodiments, platform 402 may be implemented as fabric having an integrated infrastructure that is fashioned into something other than a wearable garment (e.g., fabric for a chair or other furnishing, fabric for curtains, fabric for carpeting, etcetera). In still other alternatives, platform 402 may be implemented as a non-fabric platform that includes an infrastructure in which one or more sensors 403 may be implemented.

Transceiver 306 is communicatively coupled to the infrastructure of platform 402 to receive sensed data from the one or more sensors 403. Thus, transceiver 306 may be integrated within the infrastructure of platform 402, or otherwise communicatively coupled to such infrastructure. Wireless gateway 310_A is included within environment 400 to receive the sensed data from transceiver 306 and communicate such data, either directly or indirectly, to a central server, which in this exemplary implementation is a web-based server 406. More specifically, in this exemplary implementation, wireless gateway 310_A communicates the sensed data to a base unit 404, which in turn communicates the sensed data to web-based server 406 via fixed transmission facility (e.g., the Internet, PSTN, private data network, or other suitable communication network). Transceiver 306 may communicate the sensed data to wireless gateway 310_A via a first wireless protocol (e.g., via short-range radio protocol, such as Bluetooth), and wireless gateway 310_A translates the data to a second wireless protocol (e.g., WLAN, infrared, PAN, cellular, or other wireless protocol) that is suitable for communicating with base unit 404. Base unit 404 communicates the sensed data in a suitable protocol (e.g., Internet Protocol) to web-based server 406.

Web-based server 406 may include one or more software application programs 408 executing thereon to process the received sensed data. Additionally, a processor-based

device 316 (e.g., workstation, PC, or laptop) may be communicatively coupled to web-based server 406 to enable a user to input information to web-based server 406 and/or to receive output of information from web-based server 406. For example, a user may utilize processor-based device 316 to monitor and/or analyze the received sensed data. For instance, a user may interact with application programs 408 to monitor/analyze the physical characteristics represented by the sensed data (e.g., a patient's vital signs). As further shown in Fig. 4, a data storage device 407 may be communicatively coupled to central server 406 to enable central server 406 to store the sensed data thereto. Such data storage device 407 may be implemented as any suitable data storage device, including without limitation RAM, a hard drive, floppy disk, or writeable CD-ROM. Furthermore, sensed data and/or data output by application programs 408 may be stored to data storage device 407 as one or more databases. Accordingly, in a preferred embodiment, a user may utilize processor-based device 316, for example, to query the data collected by the central server 406 in data storage device 407. For instance, a user may utilize Standard Query Language (SQL) or may otherwise interact with an application program 408 to query data for one or more patients collected in data storage device 407. As a result, reports including data from data storage device 407 may be generated, for instance, in hypertext markup language (HTML), Dynamic hypertext markup language (DHTML), extensible markup language (XML), extensible hypertext markup language (XHTML), standard generalized markup language (SGML), or other appropriate format for displaying to the user on processor-based device 316.

Furthermore, a processor-based handheld device 308 (e.g., PDA or PSM) may be communicatively coupled to transceiver 306 and/or wireless gateway 310_A. Thus, a user may receive sensed data from transceiver 306 and/or wireless gateway 310_A, and the user may then analyze/monitor the sensed data using handheld device 308. Handheld device 308 may execute one or more application programs, such as application programs 408, to aid a user in evaluating the received sensed data information. Most preferably, handheld device 308 communicates in the same protocol in which transceiver 306 communicates to enable handheld device 308 to receive information directly from such transceiver 306. Of course, wireless gateway 310_A may be utilized to forward sensed data to handheld device 308 if, for example, handheld device 308 is not within communication range of transceiver 306.

Additionally, handheld device 308 may provide redundancy or backup in the event of communication failure with web-based server 406. For instance, within the health care arena, a patient may have personal data (e.g., vital sign data) communicated from transceiver 306 to wireless gateway 310_A, which communicates the data to base unit 404, which communicates the data to web-based server 406. A physician, nurse, or other care giver may utilize handheld device 308 to receive sensed data for one or more patients for which such care giver is responsible in order to monitor the patients. More specifically, wireless gateway 310_A may communicate sensed data to handheld device 308 in substantially real-time. However, handheld device 308 is most preferably implemented to enable communication directly with transceiver 306, such that if a failure occurs, for example, with wireless gateway 310_A, a care giver has the ability to monitor a patient with handheld device 308. Furthermore, such a handheld device 308 may be utilized by a patient being monitored to provide information (e.g., monitoring information and/or instructions) to the patient. For example, software may execute on handheld device 308 to analyze the patient's sensed data, and provide information/instructions to the patient based on the sensed data. Additionally, a patient may receive via handheld device 308 instructions from a care giver, which the care giver may communicate, for example, from another handheld device 308 and/or via web-based server 406 using workstation 316.

Fig. 5 shows an exemplary implementation of a preferred embodiment within a hospital environment 500 for communication of sensed data within the hospital environment. As shown, platform 402 is again provided, which includes one or more sensors 403. As described in conjunction with Fig. 4, in a most preferred embodiment, platform 402 may be implemented as fabric that includes an integrated infrastructure in which sensors 403 may be implemented, and such fabric may be fashioned into a wearable garment, which may be worn by a patient to enable sensors 403 to sense personal data (e.g., vital sign data) for such patient. Also shown is transceiver 306, which is communicatively coupled to the infrastructure of platform 402 to receive sensed data from the one or more sensors 403. Thus, transceiver 306 may be integrated within the infrastructure of platform 402, or otherwise communicatively coupled to such infrastructure.

Wireless gateway 310_B is included within environment 500 to receive the sensed data from transceiver 306 and communicate such data, either directly or indirectly, to a central server, which in this exemplary implementation is again shown as web-based server

406. More specifically, in this exemplary implementation, wireless gateway 310_B communicates the sensed data to base unit 404_A, which in turn communicates the sensed data to web-based server 406. Transceiver 306 may communicate the sensed data to wireless gateway 310_B via a first wireless protocol, and wireless gateway 310_B translates the data to a second wireless protocol that is suitable for communicating with base unit 404_A within the hospital environment 500. For instance, transceiver 306 may communicate the sensed data to wireless gateway 310_B via Bluetooth protocol, and wireless gateway 310_B may translate the data to WMTS, which is a suitable protocol for transmission within hospital environment 500. Thus, wireless gateway 310_B may communicate the sensed data to base unit 404_A using WMTS protocol, and base unit 404_A may then communicate the sensed data in a suitable protocol (e.g., Internet Protocol) to web-based server 406 via the hospital's Intranet 502 or other communication network.

In this exemplary implementation, a patient may have data sensed by sensors 403, which may, for instance, be communicatively coupled to an infrastructure of a wearable garment, and the sensed data is received from the sensors 403 at transceiver 306, which in turn transmits the sensed data using Bluetooth protocol to wireless gateway 310_B. It should be recognized that transceiver 306 may be capable of communicating the data only a limited distance, shown as D_1. For example, to save on power consumption, transceiver 306 may be capable of communicating at only a relatively short distance. Thus, for instance the distance D_1 within which transceiver 306 is capable of communicating the sensed data may be approximately 30 feet. Accordingly, wireless gateway 310_B is preferably maintained within relative close proximity of transceiver 306 to enable wireless gateway 310_B to receive the sensed data from transceiver 306. For instance, wireless gateway 310_B may be placed beside the bed of a patient within hospital 500, or the wireless gateway 310_B may be clipped to the clothing of such patient, as examples.

Wireless gateway 310_B is preferably capable of communicating at a further distance than transceiver 306, shown as distance D_2. Thus, for instance, distance D_2 within which wireless gateway transceiver is capable of communicating the sensed data may be approximately 300 feet. Accordingly, base unit 404_A is preferably maintained within range of wireless gateway 310_B (e.g., within distance D_2) to enable base unit 404_A to receive the sensed data from wireless gateway 310_B. For instance, base unit 404_A may be placed at a

nurses station on the floor of hospital 500 on which a patient being monitored is located, as an example.

In a most preferred embodiment, wireless gateway 310_B includes the capability of communicating via a wireline protocol. For example, wireless gateway 310_B preferably includes a connector for being communicatively coupled to communication network 502 via a wireline connection 503. For example, wireless gateway 310_B may include a telephone jack connection (e.g., an RJ-11 connector) or an RJ-45 connector with a standard modem for communicating with network 502. Accordingly, wireless gateway 310_B may provide further flexibility by enabling not only wireless communication, but also wireline communication. Thus, for example, if wireless communication with base unit 404_A is interrupted (e.g., base unit 404_A fails), wireless gateway 310_B may utilize wireline connection 503 to maintain communication with central server 406.

Fig. 6 shows an exemplary implementation that enables communication of sensed data from a particular base location 600, such as a patient's home, to a central server. As shown, platform 402 including one or more sensors 403, transceiver 306, wireless gateway 310_C, and base unit 404_B may be implemented within a base location (e.g., a patient's home) 600. In this exemplary implementation, wireless gateway 310_C receives sensed data from transceiver 306 and communicates the sensed data to base unit 404_B, which in turn communicates the sensed data to web-based server 406. Thus, for example, transceiver 306 may communicate the sensed data to wireless gateway 310_C via a first wireless protocol, and wireless gateway 310_C translates the data to a second wireless protocol that is suitable for communicating with base unit 404_B within the base location (e.g., patient's home) 600. For instance, transceiver 306 may communicate the sensed data to wireless gateway 310_C via Bluetooth protocol, and wireless gateway 310_C may translate the data to 802.11, which is a suitable protocol for communication with base unit 404_B. Thus, wireless gateway 310_C may communicate the sensed data to base unit 404_B using 802.11 protocol, and base unit 404_B may then communicate the sensed data in a suitable protocol (e.g., Internet Protocol) to web-based server 406 via the Internet 602 or other communication network. As examples, base unit 404_B may access Internet 602 via a cable modem or DSL connection, or base unit 404_B may access an Internet Service Provider (ISP) 604 via an analog or ISDN dial-up modem in order to communicate the sensed data over Internet 602.

In this exemplary implementation, a patient may have physical characteristics sensed by sensors 403, which may, for instance, be communicatively coupled to an infrastructure of a wearable garment, and the sensed data is received from the sensors 403 at transceiver 306, which in turn transmits the sensed data using Bluetooth protocol to wireless gateway 310_C. As described above, transceiver 306 may be capable of communicating the data only a limited distance D_1 (e.g., 30 feet). Accordingly, wireless gateway 310_C is preferably maintained within relative close proximity of transceiver 306 to enable wireless gateway 310_C to receive the sensed data from transceiver 306. For instance, wireless gateway 310_C may be clipped to the clothing of such patient, carried in a purse (or other handbag, such as a diaper bag), arranged within room(s) of the patient's house, or may actually be implemented within (or coupled to) handheld device 308, which the patient keeps with him/her, as examples.

Wireless gateway 310_C is preferably capable of communicating at a further distance than transceiver 306, shown as distance D_2 (e.g., 300 feet). Accordingly, base unit 404_B is preferably maintained within range of wireless gateway 310_C (e.g., within distance D_2) to enable base unit 404_B to receive the sensed data from wireless gateway 310_C. For instance, one or more base unit(s) 404_B may be strategically placed within the base location 600 to enable such one or more base unit(s) 404_B to be within communication range of wireless gateway 310_C within base location 600. For example, one or more base units 404_B may be strategically placed within a patient's home (base location 600) to enable communication between wireless gateway 310_C and base unit(s) 404_B within the patient's home. Accordingly, this exemplary implementation enables a patient to be monitored by central server 406 from the patient's home. Again, wireless gateway 310_C most preferably includes the capability of communicating via a wireline protocol. For example, wireless gateway 310_C most preferably includes a connector for being communicatively coupled to Internet 602 (or ISP 604) via a wireline connection 603 (e.g., a telephone jack connection with a standard modem for communicating with Internet 602).

Fig. 7 shows an exemplary implementation that further enables communication of sensed data from a wide area to a central server. That is, Fig. 7 shows an exemplary implementation that enables communication of sensed data from areas outside of the base location 600 (e.g., outside the patient's home). As shown, platform 402 including one or more sensors 403, transceiver 306, wireless gateway 310_D, and base unit 404_B may be

implemented within a base location (e.g., a patient's home) 600. In this exemplary implementation, wireless gateway 310_D receives sensed data from transceiver 306 and communicates the sensed data to base unit 404_B, which in turn communicates the sensed data to web-based server 406, in the manner described above in conjunction with Fig. 6. However, in this exemplary implementation, wireless gateway 310_D is further capable of communicating sensed data to web-based server 406 from within base location 600 or outside of base location 600. More specifically, in this exemplary implementation, wireless gateway 310_D is capable of communicating via one or more cellular protocols, such as CDPD, EDGE, HDR, CDMA, or WCDMA. Thus, for example, transceiver 306 may communicate the sensed data to wireless gateway 310_D via a first wireless protocol, and wireless gateway 310_D may translate the data to a second wireless protocol that is suitable for communicating via cellular network 702, which may in turn be communicatively coupled to Internet 602 for communicating data to web-based server 406. For instance, transceiver 306 may communicate the sensed data to wireless gateway 310_D via Bluetooth protocol, and wireless gateway 310_D may translate the data to a cellular protocol for communication central server 406 via cellular network 702 (which may be communicatively coupled to Internet 602). Thus, wireless gateway 310_D may communicate the sensed data to cellular network 702 using an appropriate cellular protocol, and the cellular network may then communicate the sensed data in a suitable protocol (e.g., Internet Protocol) to web-based server 406 via the Internet 602 or other communication network. As an example, as is well-known in the art, a packet data gateway within the cellular network may be utilized to communicate the sensed data in a suitable protocol to web-based server 406.

In this exemplary implementation, a patient may have data sensed by sensors 403, which may, for instance, be communicatively coupled to an infrastructure of a wearable garment, and the sensed data is received from the sensors 403 at transceiver 306, which in turn transmits the sensed data using Bluetooth protocol to wireless gateway 310_D. As described above, transceiver 306 may be capable of communicating the data only a limited distance D_1 (e.g., 30 feet). Accordingly, wireless gateway 310_D is preferably maintained within relative close proximity of transceiver 306 to enable wireless gateway 310_D to receive the sensed data from transceiver 306. For instance, wireless gateway 310_D clipped to the clothing of such patient, carried in a purse (or other handbag, such as a diaper bag),

or may actually be implemented within (or coupled to) handheld device 308, which the patient keeps with him/her, as examples

Because wireless gateway 310_D is capable of communicating via cellular communication in this exemplary implementation, such wireless gateway 310_D is capable of communicating at a much further distance than transceiver 306. In this implementation, if wireless gateway 310_D is within range of base unit 404_B, then base unit 404_B is preferably used to communicate with central server 406. However, if communication between base unit 404_B and wireless gateway 310_D is interrupted (e.g., wireless gateway 310_D is not within range for communication with base unit 404_B, or the communication there between is otherwise interrupted), wireless gateway 310_D may utilize cellular network 702 to communicate with central server 406, as well as other suitable third parties 703, such as a 911 operator. As will be described in greater detail hereafter, in a most preferred embodiment, wireless gateway 310_D may be implemented with an amount of intelligence for analyzing sensed data received from transceiver 306. For example, wireless gateway 310_D may be capable of recognizing critical conditions indicated by the sensed data, and may utilize cellular network 702 to contact 911, central server 406, or otherwise make an emergency call to notify appropriate personnel of the critical condition.

Turning to Fig. 8, an exemplary implementation that enables communication of sensed data within a wide area of communication is shown. In this exemplary implementation, a particular base area (e.g., a patient's home) may not be defined for a user, and a base unit is not included for use within such a particular base area, but instead a wide area communication, such as cellular communication, may be utilized for communicating sensed data to central server 406. That is, Fig. 8 shows an exemplary implementation that enables communication of sensed data within a wide area utilizing wide area communication, such as cellular communication. In this exemplary implementation, wireless gateway 310_E receives sensed data from transceiver 306 and communicates the sensed data to central server 406 via cellular network 702. More specifically, in this exemplary implementation, wireless gateway 310_E is capable of communicating via one or more cellular protocols, such as CDPD, EDGE, HDR, CDMA, or WCDMA. Thus, for example, transceiver 306 may communicate the sensed data to wireless gateway 310_E via a first wireless protocol, and wireless gateway 310_E may translate the data to a second wireless protocol that is suitable for communicating via

cellular network 702, which may in turn be communicatively coupled to Internet 602 for communicating data to web-based server 406. For instance, transceiver 306 may communicate the sensed data to wireless gateway 310_E via Bluetooth protocol, and wireless gateway 310_E may translate the data to a cellular protocol for communication to central server 406 via cellular network 702 (which may be communicatively coupled to Internet 602). Thus, wireless gateway 310_E may communicate the sensed data to cellular network 702 using an appropriate cellular protocol, and the cellular network may then communicate the sensed data in a suitable protocol (e.g., Internet Protocol) to web-based server 406 via the Internet 602 or other communication network.

In this exemplary implementation, a patient may have physical characteristics sensed by sensors 403, which may, for instance, be communicatively coupled to an infrastructure of a wearable garment, and the sensed data is received from the sensors 403 at transceiver 306, which in turn transmits the sensed data using Bluetooth protocol to wireless gateway 310_E. As described above, transceiver 306 may be capable of communicating the data only a limited distance D_1 (e.g., 30 feet). Accordingly, wireless gateway 310_E is preferably maintained within relative close proximity of transceiver 306 to enable wireless gateway 310_E to receive the sensed data from transceiver 306. For instance, wireless gateway 310_E may be clipped to the clothing of such patient, carried in a purse (or other handbag, such as a diaper bag), or may actually be implemented within (or coupled to) handheld device 308, which the patient keeps with him/her, as examples.

Because wireless gateway 310_E is capable of communicating via cellular communication in this exemplary implementation, such wireless gateway 310_E is capable of communicating at a much further distance than transceiver 306. In this implementation, wireless gateway 310_E utilizes cellular network 702 to communicate with central server 406, as well as other suitable third parties 703, such as a 911 operator. Wireless gateway 310_E may only periodically communicate data to central server 406 via cellular network 702. For example, wireless gateway 310_E may only access central server 406 via cellular network 702 periodically or upon detection of particular conditions of the sensed data. For instance, wireless gateway 310_E may store an hour's worth of sensed data, and only access central server 406 via cellular network 702 once an hour for transmission of the data. As will be described in greater detail hereafter, in a most preferred embodiment, wireless gateway 310_E may be implemented with an amount of intelligence for analyzing sensed

data received from transceiver 306. Accordingly, wireless gateway 310_E may be capable of recognizing critical conditions indicated by the sensed data, and may utilize cellular network 702 to contact 911, central server 406, or otherwise make an emergency call to notify appropriate personnel of the critical condition.

An exemplary implementation of transceiver 306 that may be utilized in a preferred embodiment is shown in Fig. 9. Of course, it should be recognized that any other suitable implementation of such transceiver 306 now known or later developed may be utilized, and any such implementation is intended to be within the scope of the present invention.

In a most preferred embodiment, sensed data communicated to wireless gateway 310 includes information in addition to the actual sensed data. For example, in a most preferred embodiment, the sensed data includes physical characteristic type, source identification, time stamp, and location information. Of course, additional information may also be included. The physical characteristic type information identifies the type of physical characteristic that the sensed data represents. For instance, the physical characteristic type information may identify certain sensed data as representing heart rate data and other sensed data as representing body temperature information. Source identification information identifies the source of the physical characteristic, such as a particular patient or a particular platform from which the physical characteristic was obtained. For instance, source identification information may identify a particular patient from which the sensed data was obtained, such as the patient's name, social security number, or other identifier. Such source identification may further include contact information for quickly reaching the source, such as a patient's room number within a hospital, a patient's address, and the patient's telephone number. Time stamp information identifies the specific date and time at which the sensed data was actually obtained. Location information identifies the location of the source of such sensed data. For instance, location information may identify the exact location (e.g., address) at which a patient is located at the time of obtaining the sensed data (e.g., such information may be acquired using a global positioning system for instance).

In a preferred embodiment, data may be temporarily stored in any suitable data storage device, such as a hard drive, floppy disk, or writeable CD-ROM, that is communicatively coupled to wireless gateway 310, and wireless gateway 310 may periodically communicate such data to the central server. Thus, wireless gateway 310 may

not be required to maintain a constant communication connection with the central server, but may instead only periodically establish such a connection to communicate the data. Furthermore, as described in greater detail in concurrently filed and commonly assigned U.S. Patent Application Serial Number 09/676,382 entitled "WIRELESS GATEWAY CAPABLE OF COMMUNICATING ACCORDING TO A PLURALITY OF PROTOCOLS," the disclosure of which is hereby incorporated herein by reference, wireless gateway 310 of a most preferred embodiment may be capable of performing at least a limited amount of analysis of the sensed data. Accordingly, wireless gateway 310 may, based on the sensed data, determine that communication with the central server (or an appropriate third party) should be initiated. For example, wireless gateway 310 may determine that heart rate data it receives is at a critical (or dangerous) level or is otherwise abnormal, and may in response to receiving such data initiate communication with the central server to immediately communicate the data to such central server in order to alert a monitoring care giver. Alternatively (or in addition thereto), wireless gateway 310 may initiate a call to 911 (or other emergency personnel) to request immediate medical attention for the monitored patient. As described above, the data most preferably includes information identifying the monitored patients name, location (e.g., address), and other information, which wireless gateway 310 may use to properly notify emergency personnel of the situation.

Furthermore, in a preferred embodiment, wireless gateway 310 may determine an appropriate communication method or protocol to use based on the sensed data. For example, in the exemplary implementation of Fig. 7, wireless gateway 310_D may based upon the sensed data determine to use either protocol 802.11 (or other suitable protocol) to communicate to central server 406 via base unit 404_B or cellular network 702 to communicate to central server 406 or a suitable third party 703. For instance, wireless gateway 310_D may receive heart rate data, and upon determining that the heart rate data is not at a critical or otherwise abnormal level, wireless gateway 310_D may communicate the sensed data to central server 406 via base unit 404_B. On the other hand, wireless gateway 310_D may determine that heart rate data it receives is at a critical (or dangerous) level or is otherwise abnormal, and may in response to receiving such data initiate communication with central server 406 or a third party 703 via cellular network 702 (or via a wireline network, such as PSTN). Additionally, if no communication path is available, wireless

gateway 310 may be implemented to sound an audible alarm and/or present a visual alarm (e.g., on a display that may be implemented within such wireless gateway 310).

While the various embodiments have been described above as being implemented within the health care arena (e.g., for communicating vital sign data from a patient to a central server), it should be understood that the present invention may be implemented in various other arenas. As one example, a preferred embodiment may be implemented to enable communication of sensed data (e.g., temperature data) to a temperature control system or air conditioning system (central server) responsible for controlling the temperature of a particular facility. As another example, a preferred embodiment may be implemented within a robot to detect hazardous conditions in an environment and communicate the sensed data acquired in such an environment to a central server.

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

WHAT IS CLAIMED IS:

1. A system for communicating data to a central server for processing thereon, said system comprising:

at least one sensor, each of said at least one sensor for sensing a physical characteristic and outputting data representing said physical characteristic to a transmitter;

said transmitter for communicating said data via a first wireless protocol to a wireless gateway;

said wireless gateway for translating said data from said first wireless protocol to at least a second wireless protocol and for communicating said data either directly or indirectly to a central server via said at least a second wireless protocol; and

said central server for receiving said data and processing said data.

2. The system of claim 1 further comprising:

at least one platform on which one or more of said at least one sensor is coupled.

3. The system of claim 2 wherein said at least one platform comprises fabric having an information infrastructure integrated therein.

4. The system of claim 3 wherein said fabric is fashioned into a wearable garment.

5. The system of claim 2 wherein said at least one platform provides an information infrastructure to which said at least one sensor can be removably coupled.

6. The system of claim 2 wherein said at least one platform provides an information infrastructure to which said at least one sensor is permanently coupled.

7. The system of claim 1 wherein said transmitter is a transceiver that is further capable of receiving data.

8. The system of claim 1 wherein said central server comprises a plurality of processor-based devices communicatively coupled together.

9. The system of claim 1 wherein said central server is a web-based server.

10. The system of claim 1 further comprising:

at least one intermediary for receiving data from said wireless gateway and communicating said data to said central server.

11. The system of claim 10 wherein said at least one intermediary receives said data from said wireless gateway in said at least a second wireless protocol, and wherein said at least one intermediary communicates said data to said central server in a protocol different from said at least a second wireless protocol.

12. The system of claim 11 wherein said at least a second wireless protocol is selected from the group consisting of WLAN, infrared, PAN, and cellular protocol.

13. The system of claim 11 wherein said WLAN protocol includes 802.11 and WMTS protocol.

14. The system of claim 11 wherein said at least one intermediary communicates said data to said central server using a wireline protocol.

15. The system of claim 11 wherein said at least one intermediary communicates said data to said central server using Internet Protocol.

16. The system of claim 10 herein said at least one intermediary communicates said data to said central server via a communication network.

17. The system of claim 16 wherein said communication network is selected from the group consisting of:

public switched telephone network (PSTN), wireless communication network, general purpose processor-based information network, dedicated communication lines, cable system, digital subscriber line (DSL), direct PC to PC connection, local area network (LAN), wide area network (WAN), modem to modem connection, the Internet, an Intranet, an Extranet, or any combination thereof suitable for providing information communication between said at least one intermediary and said central server.

18. The system of claim 10 wherein said intermediary comprises a processor-based device.

19. The system of claim 10 wherein said intermediary comprises a device selected from the group consisting of:

base unit and a packet data gateway within a cellular network.

20. The system of claim 1 wherein said physical characteristic is selected from the group consisting of vital sign characteristic and environmental characteristic.

21. The system of claim 20 wherein said vital sign characteristic includes heart rate, breathing rate, blood pressure, pulse, body temperature, and blood oxygen level.

22. The system of claim 20 wherein said environmental characteristic includes temperature, audio, atmospheric smoke and oxygen levels, gas level, light level, air flow, and radiation level.

23. The system of claim 1 wherein said data includes information selected from the group consisting of:

physical characteristic type, source identification, time stamp, and location information.

24. The system of claim 1 further comprising:

at least one handheld device arranged to receive said data from at least one of said transmitter, said wireless gateway, and said central server.

25. The system of claim 1 further comprising:

at least one software program executing on said central server for interpreting said data to enable a user to monitor said physical characteristic.

26. The system of claim 1 wherein said first wireless protocol and said at least a second wireless protocol are selected from the group consisting of: short-range radio protocols, WLAN protocols, infrared, PAN protocols, and cellular protocols.

27. The system of claim 26 wherein said short-range radio protocols include Bluetooth protocol, said WLAN protocols include 802.11 and wireless medical transmission standard (WMTS) protocols, and said cellular protocols include CDPD, EDGE, HDR, CDMA, and WCDMA protocols.

28. A method for communicating data to a central server for processing thereon, said method comprising:

sensing at least one physical characteristic;

generating data representing said at least one physical characteristic;

communicating said data in a first wireless protocol to a wireless gateway;

translating by said wireless gateway from said first wireless protocol to at least a second wireless protocol; and

communicating said data from said wireless gateway to a central server via a communication path, wherein at least a portion of said communication path is in said at least a second wireless protocol.

29. The method of claim 28 further comprising:

using at least one sensor to perform said sensing and said generating steps.

30. The method of claim 29 further comprising:

communicatively coupling said at least one sensor to at least one platform.

31. The method of claim 30 wherein said at least one platform comprises fabric having an information infrastructure integrated therein.

32. The method of claim 31 wherein said fabric is fashioned into a wearable garment.

33. The method of claim 30 wherein said communicatively coupling includes removably coupling said at least one sensor to said at least one platform.

34. The method of claim 28 further comprising:

using a transmitter to perform said communicating said data to said wireless gateway.

35. The method of claim 28 further comprising:

using a transceiver to perform said communicating said data to said wireless gateway.

36. The method of claim 35 further comprising:

receiving data from said wireless gateway at said transceiver.

37 . The method of claim 28 wherein said central server comprises a plurality of processor-based devices communicatively coupled together.

38 . The method of claim 28 wherein said central server is a web-based server.

39 . The method of claim 28 wherein said communicating said data from said wireless gateway to said central server via a communication path further comprises:

communicating said data from said wireless gateway to at least one intermediary; and

communicating said data from said at least one intermediary to said central server.

40. The method of claim 39 further comprising:

communicating said data from said wireless gateway to said at least one intermediary in said at least a second wireless protocol; and

communicating said data from said at least one intermediary to said central server in a protocol different from said at least a second wireless protocol.

41. The method of claim 40 wherein said at least a second wireless protocol is selected from the group consisting of WLAN, infrared, PAN, WLAN, and cellular protocol.

42. The method of claim 40 wherein said protocol different from said at least a second wireless protocol is a wireline protocol.

43. The method of claim 40 wherein said protocol different from said at least a second wireless protocol is Internet Protocol.

44. The method of claim 39 further comprising:

said at least one intermediary communicating said data to said central server via a communication network.

45. The method of claim 44 wherein said communication network is selected from the group consisting of:

public switched telephone network (PSTN), wireless communication network, general purpose processor-based information network, dedicated communication lines, cable system, digital subscriber line (DSL), direct PC to PC connection, local area network (LAN), wide area network (WAN), modem to modem connection, the Internet, an Intranet, an Extranet, or any combination thereof suitable for providing information communication between said at least one intermediary and said central server.

46. The system of claim 39 wherein said at least one intermediary comprises a processor-based device.

47. The method of claim 39 wherein said at least one intermediary comprises a device selected from the group consisting of:

base unit and a packet data gateway within a cellular network.

48. The method of claim 28 wherein said at least one physical characteristic is a characteristic selected from the group consisting of vital sign characteristic and environmental characteristic.

49. The method of claim 48 wherein said vital sign characteristic includes heart rate, breathing rate, blood pressure, pulse, body temperature, and blood oxygen level.

50. The method of claim 48 wherein said environmental characteristic includes temperature, audio, atmospheric smoke and oxygen levels, gas level, light level, air flow, and radiation level.

51. The method of claim 28 wherein said communicating said data from said wireless gateway to said central server via a communication path comprises:

periodically communicating said data from said wireless gateway to said central server.

52. The method of claim 51 further comprising:

storing said data to a data storage device communicatively coupled to said wireless gateway until said data is communicated from said wireless gateway to said central server.

53. The method of claim 28 further comprising:

determining from said data whether to immediately communicate said data to said central server; and

upon determining to immediately communicate said data, performing said step of communicating said data from said wireless gateway to said central server.

54. The method of claim 53 wherein said determining step comprises:

determining that said data represents a critical physical characteristic.

55. The method of claim 53 wherein said determining step comprises:

determining an abnormality in said data.

56. The method of claim 53 further comprising:

performing said determining step by said wireless gateway.

57. The method of claim 28 further comprising:

selecting said at least a second wireless protocol from a plurality of wireless protocols.

58. The method of claim 57 further comprising:

performing said selecting step by said wireless gateway.

59. The method of claim 57 wherein said selecting step further comprises:

selecting a wireless protocol that is available for communicating with said central server.

60. The method of claim 57 wherein said selecting step further comprises:

selecting a wireless protocol based on said data.

61. The method of claim 60 wherein said selecting step further comprises:

selecting one wireless protocol if determined that said data represents a critical physical characteristic, and selecting a different wireless protocol if determined that said data represents a non-critical physical characteristic.

62. The method of claim 28 wherein said first wireless protocol and said at least a second wireless protocol are selected from the group consisting of: short-range radio protocols, WLAN protocols, infrared, PAN protocols, and cellular protocols.

63. The method of claim 62 wherein said short-range radio protocols include Bluetooth protocol, said WLAN protocols include 802.11 and wireless medical transmission standard (WMTS) protocols, and said cellular protocols include CDPD, EDGE, HDR, CDMA, and WCDMA protocols.

64. A system for sensing at least one physical characteristic and communicating data representing said at least one physical characteristic to a central server for processing thereon, said system comprising:

at least one sensor for sensing at least one physical characteristic and outputting data representing said at least one physical characteristic to at least one wireless communication device;

said at least one wireless communication device arranged to communicate said data in at least a first wireless protocol to a wireless gateway that is operable to communicate in a plurality of wireless protocols;

said wireless gateway for translating said data from said first wireless protocol to at least a second wireless protocol and for communicating said data to a central server via a communication path, wherein for at least a portion of said communication path said data is in said at least a second wireless protocol; and

said central server for receiving said data and processing said data.

65. The system of claim 64 further comprising:

at least one platform on which one or more of said at least one sensor is coupled.

66. The system of claim 65 wherein said at least one platform comprises fabric having an information infrastructure integrated therein.

67. The system of claim 66 wherein said fabric is fashioned into a wearable garment.

68. The system of claim 65 wherein said at least one platform provides an information infrastructure to which said at least one sensor can be removably coupled.

69. The system of claim 65 wherein said at least one platform provides an information infrastructure to which said at least one sensor is permanently coupled.

70. The system of claim 64 wherein said at least one wireless communication device is a transmitter.

71. The system of claim 64 wherein said at least one wireless communication device is a transceiver that is further capable of receiving data.

72. The system of claim 64 wherein said central server comprises a plurality of processor-based devices communicatively coupled together.

73. The system of claim 64 wherein said central server is a web-based server.

74. The system of claim 64 further comprising:

at least one intermediary for receiving data from said wireless gateway and communicating said data to said central server.

75. The system of claim 74 wherein said at least one intermediary is arranged to receive said data from said wireless gateway in said at least a second wireless protocol and communicate said data to said central server in a protocol different from said at least a second wireless protocol.

76. The system of claim 75 wherein said at least a second wireless protocol is selected from the group consisting of WLAN, infrared, PAN, and cellular protocol.

77. The system of claim 75 wherein said at least one intermediary communicates said data to said central server using a wireline protocol.

78. The system of claim 75 wherein said at least one intermediary communicates said data to said central server using Internet Protocol.

79. The system of claim 74 wherein said at least one intermediary communicates said data to said central server via a communication network.

80. The system of claim 79 wherein said communication network is selected from the group consisting of:

public switched telephone network (PSTN), wireless communication network, general purpose processor-based information network, dedicated communication lines, cable system, digital subscriber line (DSL), direct PC to PC connection, local area network (LAN), wide area network (WAN), modem to modem connection, the Internet, an Intranet, an Extranet, or any combination thereof suitable for providing information communication between said at least one intermediary and said central server.

81. The system of claim 74 wherein said at least one intermediary comprises a processor-based device.

82. The system of claim 74 wherein said at least one intermediary comprises a device selected from the group consisting of:

base unit and a packet data gateway within a cellular network.

83. The system of claim 64 wherein said at least one physical characteristic includes a characteristic selected from the group consisting of vital sign characteristic and environmental characteristic.

84. The system of claim 83 wherein said vital sign characteristic includes heart rate, breathing rate, blood pressure, pulse, body temperature, and blood oxygen level.

85. The system of claim 83 wherein said environmental characteristic includes temperature, audio, atmospheric smoke and oxygen levels, gas level, light level, air flow, and radiation level.

86. The system of claim 64 wherein said at least a first wireless protocol and said at least a second wireless protocol are selected from the group consisting of: short-range radio protocols, WLAN protocols, infrared, PAN protocols, and cellular protocols.

87. The system of claim 86 wherein said short-range radio protocols include Bluetooth protocol, said WLAN protocols include 802.11 and wireless medical transmission standard (WMTS) protocols, and said cellular protocols include CDPD, EDGE, HDR, CDMA, and WCDMA protocols.

FIG. 1
(PRIOR ART)

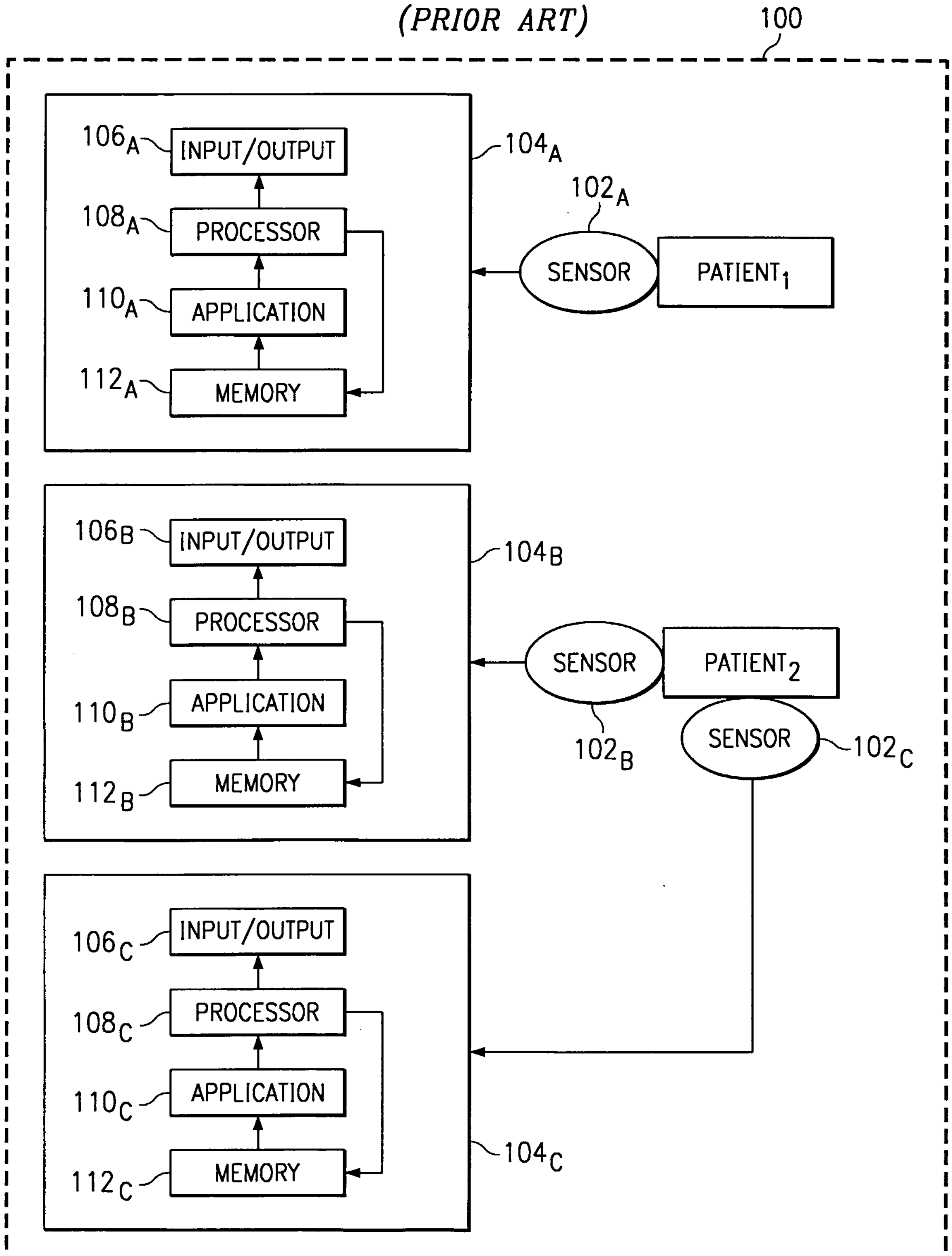


FIG. 2
(PRIOR ART)

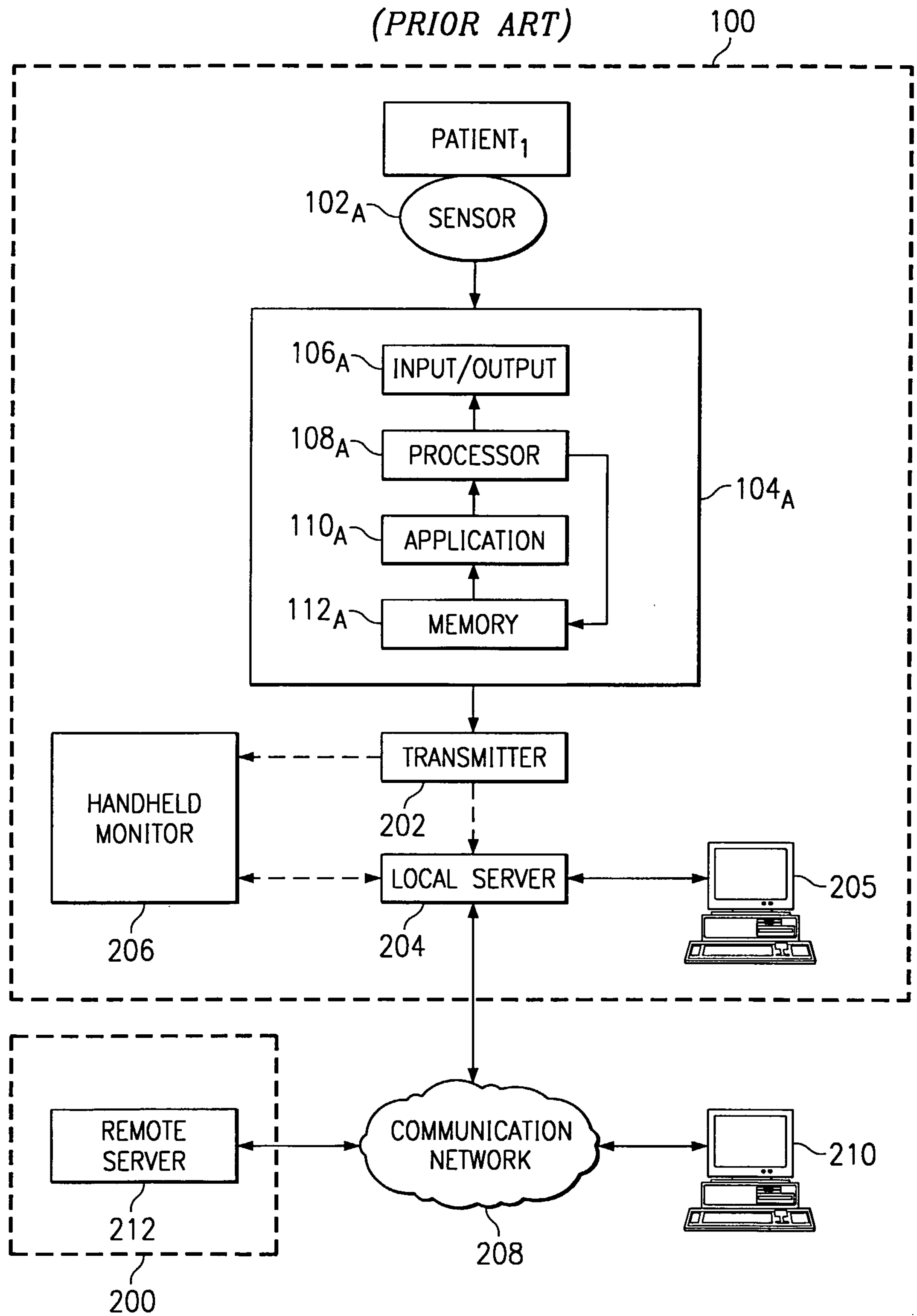
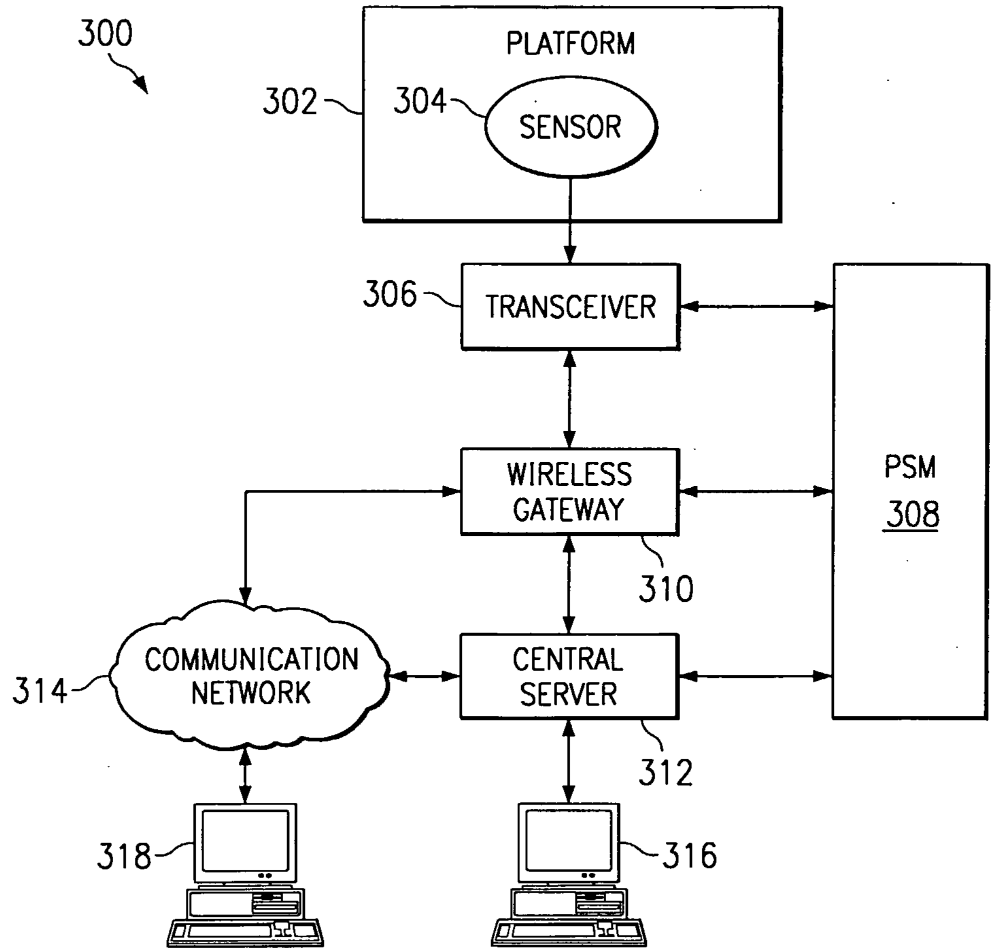


FIG. 3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SENSOR
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TRANSCEIVER
PSM
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GATEWAY
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COMMUNICATION
NETWORK
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CENTRAL
SERVER
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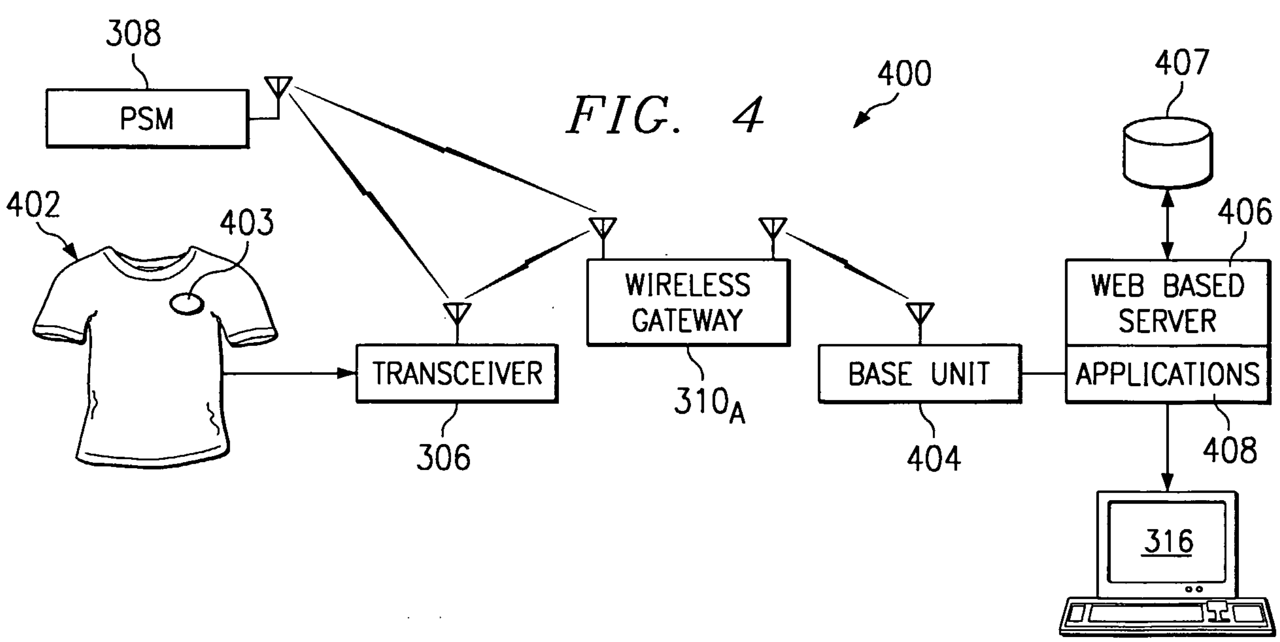
316

FIG. 4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APPLICATIONS
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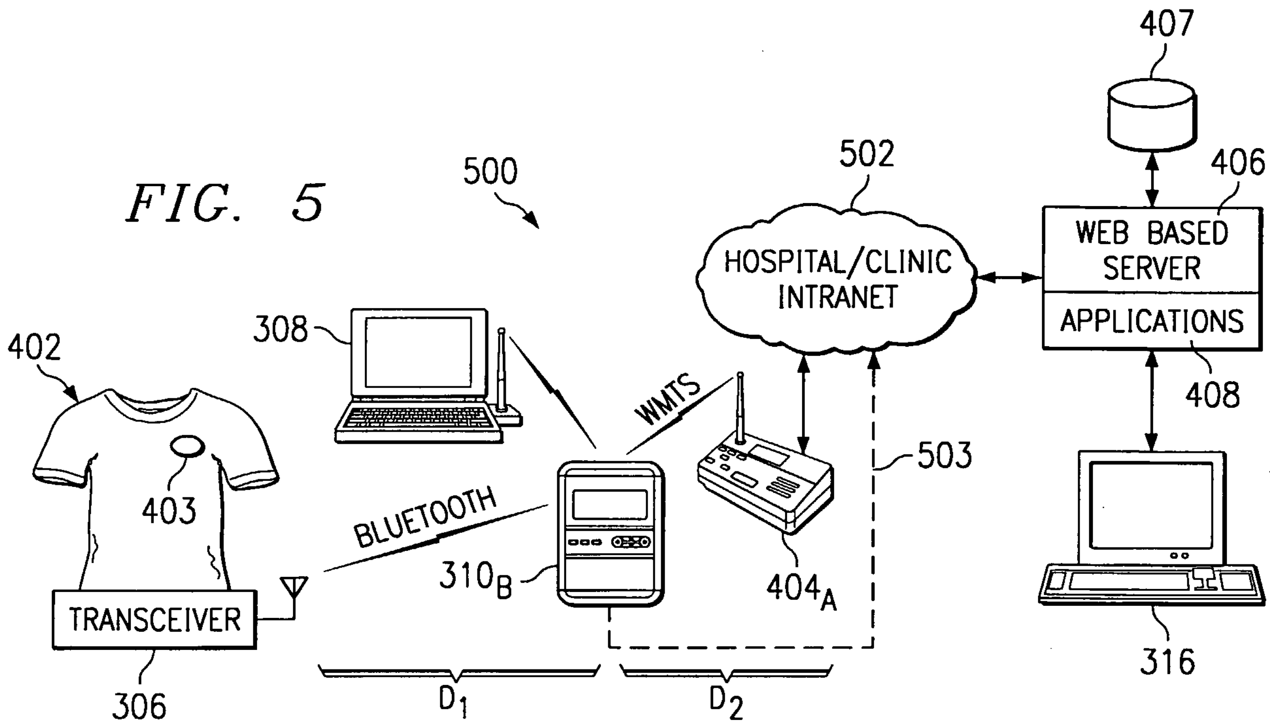
408
316

FIG. 5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WMTS
404_A
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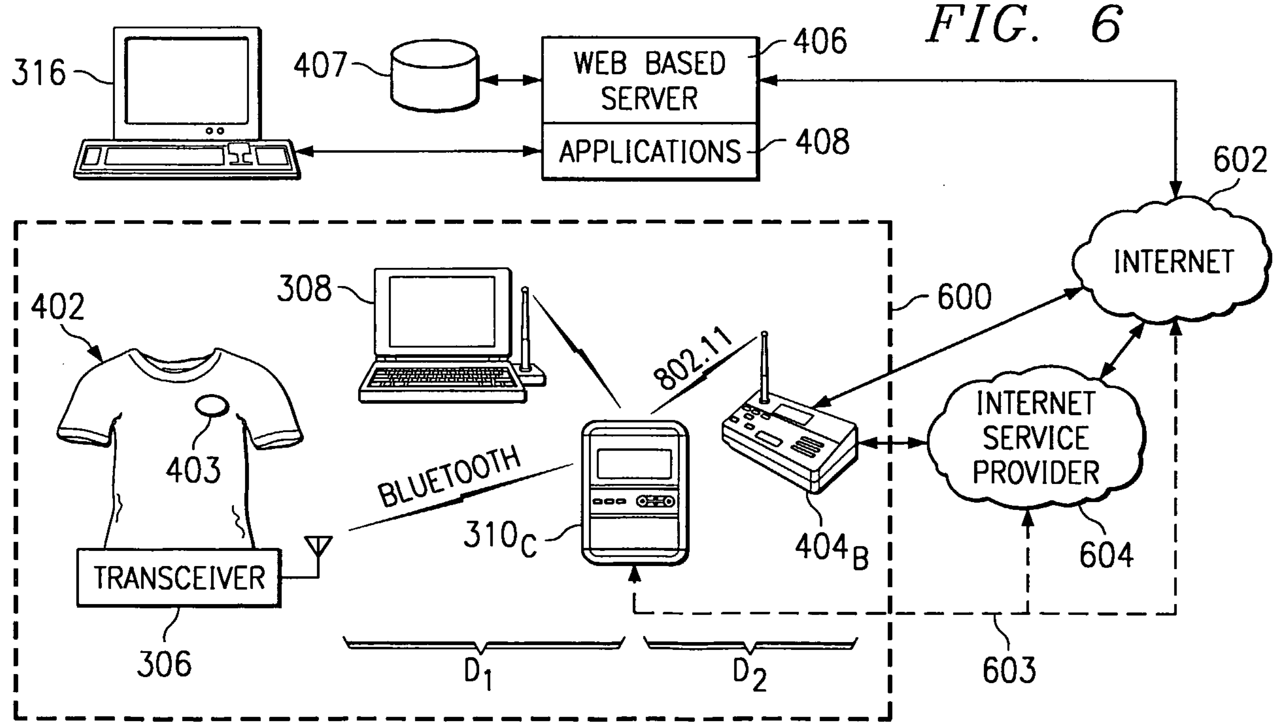
HOSPITAL/CLINIC INTRANET
503
407
406
WEB BASED SERVER
APPLICATIONS
408
316

FIG. 6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TRANSCEIVER
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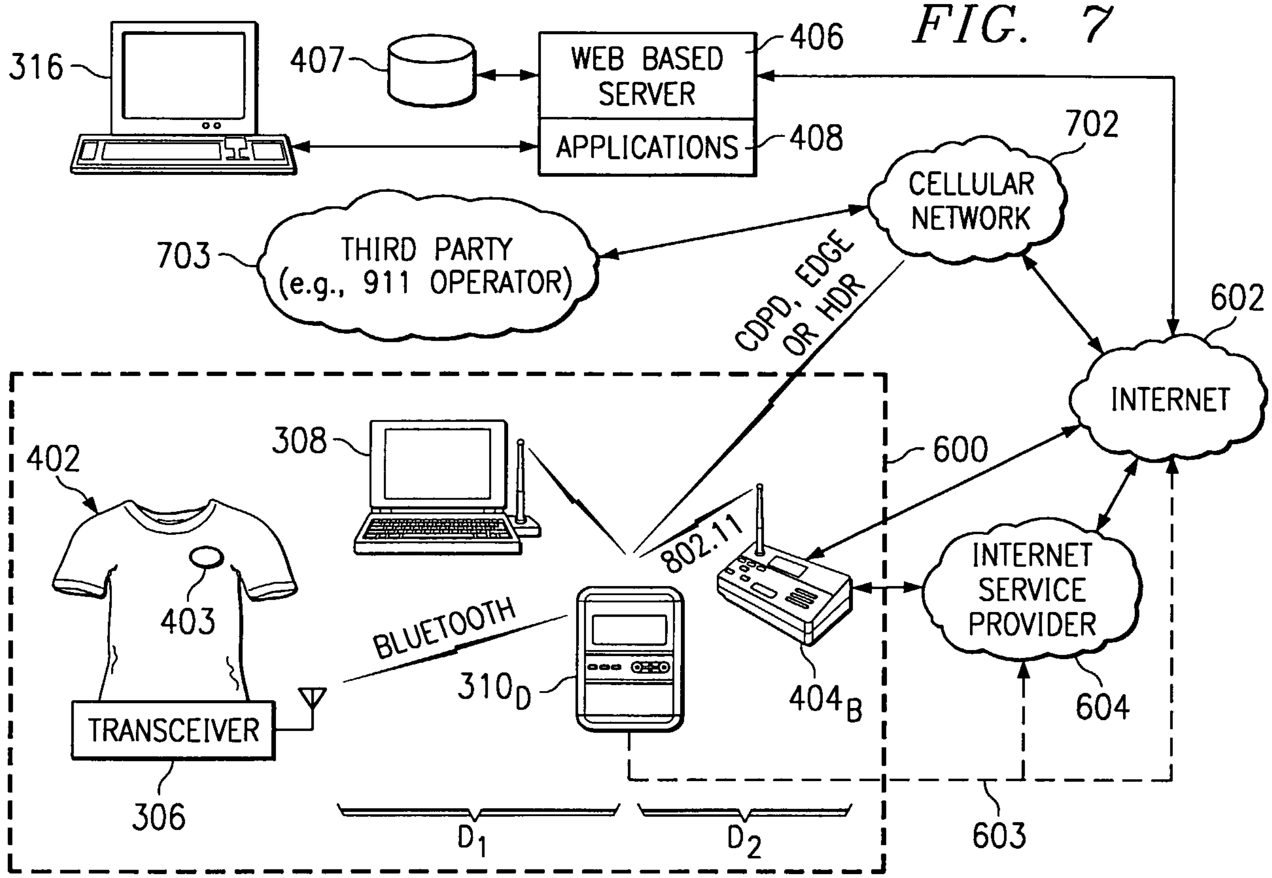
D_1
D_2
603

FIG. 7


316
407
WEB BASED SERVER
406
APPLICATIONS
408
702
CELLULAR NETWORK
703
THIRD PARTY (e.g., 911 OPERATOR)
CDPD, EDGE OR HDR
602
INTERNET
308
600
402
802.11
INTERNET SERVICE PROVIDER
403
BLUETOOTH
310_D
404_B
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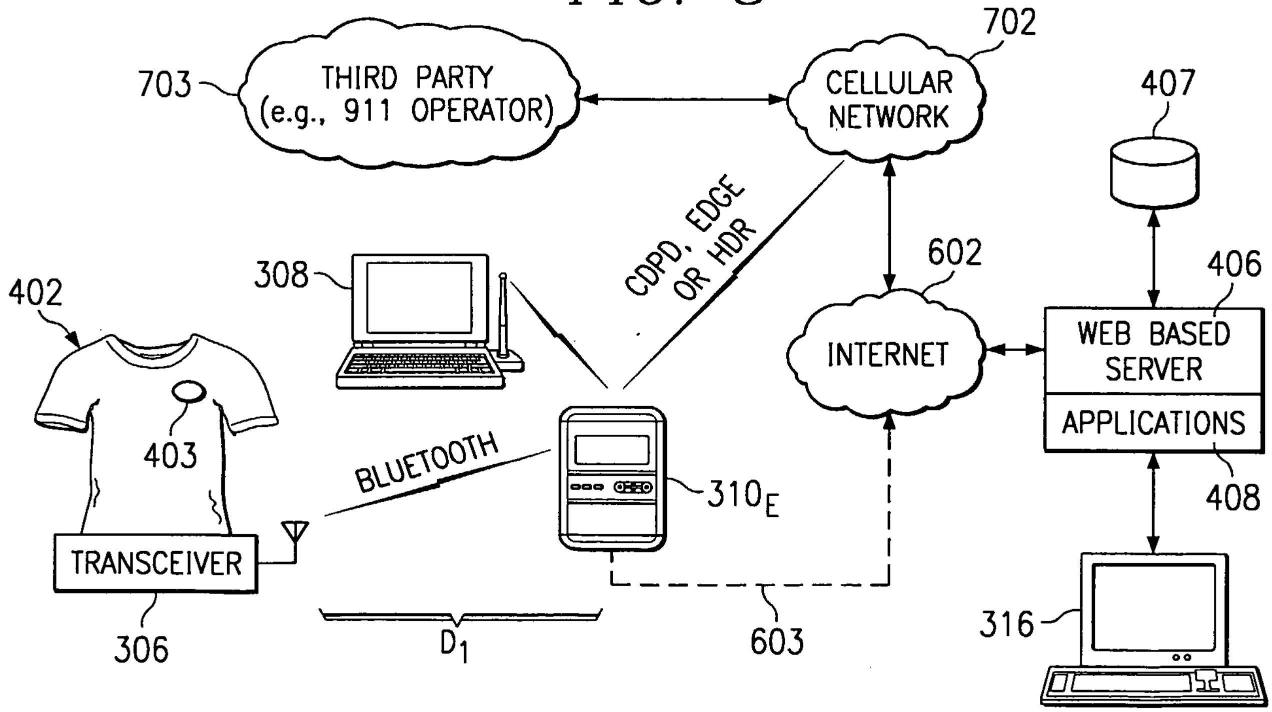
TRANSCEIVER
306
D_1
D_2
603

FIG. 8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703
THIRD PARTY (e.g., 911 OPERATOR)
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WEB BASED SERVER
APPLICATIONS
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BLUETOOTH
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TRANSCEIVER
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